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Appendix 4 to Amendment C

Claims, Clean Version with No Markings and Showing Changes Incorporated

**Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450**

**Pursuant to Rule 121, the following is a clean copy of the Pending Claims as amended by the
attached Amendment C with all changes incorporated:**

1 **Claims**

2 **What is claimed is:**

3 **27. An internal combustion engine machine incorporating significant improvements in**
4 **power, efficiency and emissions control comprising:**

5
6 **(a) one or more cylinders, each comprising at least one head, combustion**
7 **chamber, base, compression chamber and sidewall;**

8
9 **(b) one or more means of igniting fuel in the cylinder(s);**

10
11 **(c) one or more sources of intake air;**

12
13 **(d) at least one means of storing and/or cooling lubricating oil between**
14 **cycles of circulation;**

15
16 **(e) a drive train;**

17
18 **(f) at least one means of encasing, protecting, cooling and lubricating the**
19 **drive train;**

20
21 **(g) at least one means of segregating the oil in the sump and/or crankcase**
22 **from the air or air/fuel mixture in the cylinder, whether within or apart from the**
23 **combustion chamber.**

1 (h) at least one means of dispersing oil on the cylinder walls and of then
2 gathering excess for return to the oil sump;

3
4 (i) at least one means of transmitting energy to and from the pistons;

5
6 (j) at least one means of guiding each piston rod such that it moves in a
7 linear manner, always along substantially the same line;

8
9 (k) at least one means of drawing air or air/fuel mixture into the engine
10 machine, propelling it into the cylinder combustion chamber, compressing it for ignition
11 and propelling its expulsion after ignition;

12
13 (l) at least one means of admitting air and fuel, or air/fuel mixture into each
14 cylinder apart from the combustion chamber;

15
16 (m) at least one means of efficiently expelling exhaust gases resulting
17 from combustion of the air fuel mixture after energy has been extracted;

18
19 (n) at least one means of transmitting energy from the piston rod to the
20 drive train;

21
22 (o) at least one means of cooling the engine; and
23

1 (p) at least one means of transporting dispersing gathering and returning
2 lubricating/cooling oil while keeping it segregated from combustion air and fuel;

3
4 (q) wherein the means of efficiently expelling exhaust gases upon
5 completion of combustion and energy extraction comprises a cylinder head exhaust
6 valve, allowing exhaust to exit through the head of the cylinder.

7
8 28. An internal combustion engine machine incorporating significant improvements in
9 power, efficiency and emissions control comprising:

10
11 (a) one or more cylinders, each comprising a head, a combustion
12 chamber, a base, a compression chamber and a sidewall;

13
14 (b) one or more means of igniting fuel in the cylinder(s);

15
16 (c) one or more sources of intake air;

17
18 (d) at least one means of storing and/or cooling lubricating oil between
19 cycles of circulation;

20
21 (e) a drive train;

22
23 (f) at least one means of encasing, protecting, cooling and lubricating the
24 drive train;

1 (g) at least one means of segregating the oil in the sump and/or crankcase
2 from the air or air/fuel mixture in the cylinder, whether within or apart from the
3 combustion chamber.

4
5 (h) at least one means of dispersing oil on the cylinder walls and of then
6 gathering excess for return to the oil sump;

7
8 (i) at least one means of transmitting energy to and from the pistons;

9
10 (j) at least one means of guiding each piston rod such that it moves in a
11 linear manner, always along substantially the same line;

12
13 (k) at least one means of drawing air or air/fuel mixture into the engine
14 machine, propelling it into the cylinder combustion chamber, compressing it for ignition
15 and propelling its expulsion after ignition;

16
17 (l) at least one means of admitting air and fuel, or air/fuel mixture into each
18 cylinder apart from the combustion chamber;

19
20 (m) at least one means of efficiently expelling exhaust gases resulting
21 from combustion of the air fuel mixture after energy has been extracted;

22
23 (n) at least one means of transmitting energy from the piston rod to the
24 drive train;

1 (o) at least one means of cooling the engine;

2
3 (p) at least one means of transporting, dispersing, gathering, and returning

4 lubricating/cooling oil while keeping it segregated from combustion air and fuel; and

5
6 (q) at least one means of collecting, storing, and transferring inertial energy from
7 one drive stroke to another, comprising at least one inertial mass or flywheel.

8
9
10 29. An internal combustion engine machine incorporating significant improvements in
11 power, efficiency and emissions control comprising:

12
13 (a) one or more cylinders, each comprising at least one head, combustion
14 chamber, base, compression chamber and sidewall;

15
16 (b) one or more means of igniting fuel in the cylinder(s);

17
18 (c) one or more sources of intake air;

19
20 (d) at least one means of transporting dispersing gathering and returning
21 lubricating and ,or, or, cooling oil;

22
23 (e) at least one means of storing and/or cooling lubricating oil between
24 cycles of circulation;

1 (f) at least one means of dispersing lubricating oil on the cylinder walls and
2 of then gathering excess for return to an oil sump;

3
4 (g) at least one means of segregating lubricating oil from the combustion
5 air or air/fuel mixture, and combustion products at substantially all points in the engine.

6
7 (h) at least one drive train;

8
9 (i) at least one means of, protecting, cooling and, or, or, lubricating the
10 drive train;

11 (j) at least one means of transmitting energy to and from the pistons;

12
13 (k) at least one means of guiding each piston rod such that it moves in a
14 linear manner, always along substantially the same line;

15
16 (l) at least one means of drawing air or air/fuel mixture into the engine
17 machine, of propelling it into the cylinder combustion chamber, of compressing it for
18 ignition, and of propelling its expulsion after ignition;

19
20 (m) at least one means of admitting air, fuel, or an air/fuel mixture into
21 each cylinder; apart from the combustion chamber.

22
23 (n) at least one means of expelling exhaust gases resulting from
24 combustion of the air fuel mixture after energy has been extracted;

1 (o) at least one means of transmitting energy from the piston rod to the
2 drive train;

3
4 (p) at least one means of cooling the engine; and

5
6 (q) at least one means of expelling exhaust gases upon completion of
7 combustion and energy extraction comprising at least one cylinder head exhaust valve,
8 allowing exhaust to exit through the head of the cylinder.

9
10 30. An internal combustion engine machine as in claim 27 comprising at least one
11 plurality of cylinders in one or more banks of two opposing cylinders each.

12
13 31. An internal combustion engine machine as in claim 27 wherein the means of
14 transmitting energy to and from the each piston comprises;

15
16 (a) at least one piston-rod with a piston attached at one end;

17
18 (b) each piston rod passing through the base of its cylinder, carrying the
19 force of its associated piston power stroke to the drive train;

20
21 (c) the piston rod linked to the drive shaft by at least one push rod in the
22 crankcase/oil sump, propelling at least one transmission mechanism, comprising at
23 least one crank-plate, or other rotary, or linier device powering at least one drive shaft.

1 32. An internal combustions engine machine as in claim 27 wherein the means of
2 cooling the engine comprises exhaust gas expansion, cooling fins and at least one
3 volume of oil circulated through the cylinders and pooled in the sump, the sump acting
4 as at least one heat sink for oil circulating from the cylinders.

5
6 33. An internal combustion engine machine as in claim 27 wherein the means of
7 transmitting energy from the piston rod to the drive train comprises at least one rotary
8 device, linked to the piston rod by at least one push rod.

9
10 34. An internal combustion engine machine in claim 27 in which the means of
11 transmitting energy from the piston rod to the drive train comprises at least one rack and
12 pinion transmission system, segmented gear drive, or ratchet device.

13
14 35. An internal combustion engine machine as in claim 27 wherein the means of
15 admitting the fuel component of the air/fuel mixture into each cylinder comprises at least
16 one fuel injector for each cylinder.

17
18 36. An internal combustion engine machine as in claim 27 wherein the means of
19 admitting air or air/fuel mixture into each cylinder obtained by intake ports in the sidewall
20 of each cylinder.

21
22 37. An internal combustion engine machine as in claim 27 wherein the means of
23 efficiently expelling exhaust gases upon completion of combustion and energy

1 extraction comprises at least one cylinder head exhaust valve, allowing exhaust to exit
2 through the head of the cylinder.

3
4 38. An internal combustion engine machine as in claim 27 wherein a means of drawing
5 air or air/fuel mixture into the system, propelling it into the cylinder combustion chamber,
6 compressing it for ignition and expelling it after ignition comprises at least one multi-
7 function piston, that:

8
9 (a) on upstroke, draws air from an intake source and into an
10 intake/compression chamber beneath the piston, at the same time, compressing an
11 air/fuel mixture in the cylinder combustion chamber above the piston, and then,

12
13 (b) on down stroke, following combustion of the air/fuel mixture,
14 compresses and propels scavenge air out of the intake/compression chamber below the
15 piston, and into the cylinder combustion chamber above the piston, then,

16
17 (c) on the following up-stroke, expels the scavenge air and remaining
18 exhaust from the combustion chamber, at the same time drawing combustion air or a
19 combustion air/fuel mixture into an intake/compression chamber below the piston, then,

20
21 (d) on the following down stroke; compresses and propels the combustion
22 air or air/fuel mixture, out of the intake/compression chamber below the piston, and into
23 the cylinder combustion chamber above the piston, for combustion, completing a cycle.

1 39. An internal combustion engine machine as in claim 27 wherein a means of drawing
2 air or air/fuel mixture into the system, propelling it into the cylinder combustion chamber,
3 compressing it for ignition and expelling it after ignition comprises a two stroke process
4 wherein at least one multi-function piston:

5
6 (a) on a single up stroke, draws combustion air or air/fuel mixture from the
7 intake source and into an intake/compression chamber beneath the piston, and
8 compresses the air or air/fuel mixture in the combustion chamber, then,

9
10 (b) upon combustion, on a single down stroke, propels combustion air or
11 air fuel mixture out of the compression chamber into a cylinder combustion chamber
12 above the piston, at the same time expelling the exhaust from the combustion chamber
13 and completing the combustion/exhaust cycle.

14
15 40. An internal combustion engine machine as in claim 27 wherein the means of guiding
16 each piston rod such that it moves in a linear manner, always along substantially the
17 same line, comprises at least one compression wall and at least one piston rod
18 compression seal, the compression seal serving as a piston rod guide to hold each
19 piston in correct position within its cylinder.

20
21 41. An internal combustion engine machine as in claim 27 wherein there is provided for
22 each cylinder, at least one multi-function piston performing in four strokes, intake,
23 compression, combustion, exhaust and power functions plus lubrication, these
24 comprising, to:

1 (a) draw in new combustion air or air/fuel mixture into an
2 intake/compression chamber, separate from the cylinder combustion chamber,

3
4 (b) compress and propel the new air or air/fuel mixture from the
5 intake/compression chamber, into the cylinder combustion chamber,

6
7 (c) compress the air/fuel mixture in the cylinder combustion chamber,

8
9 (d) draw in scavenge air into an intake/compression chamber, separate
10 from the cylinder combustion chamber,

11 (e) receive the force of combustion for transmission to the piston rod,

12
13 (f) compress and propel the scavenge air from the intake/compression
14 chamber, into the cylinder combustion chamber,

15
16 (g) compress and propel the scavenge air and combustion by-products
17 from the cylinder combustion chamber as exhaust, and

18
19 (h) receive, disperse and recoup lubricating oil for return to the oil
20 sump/cooler.

21
22 42. An internal combustion engine machine as in claim 27 wherein there is provided for
23 each cylinder, at least one multi-function piston performing, in two strokes, intake,

1 compression, combustion, exhaust and power functions plus lubrication, these
2 comprising, to:

3
4 (a) in a single upstroke, draw new combustion air or air/fuel mixture into
5 an intake/compression chamber, separate from a cylinder combustion chamber, and in
6 the same action, compress an air/fuel mixture in the cylinder combustion chamber,

7
8 (b) receive the force of combustion for transmission to the piston rod,

9
10 (c) in a single down-stroke, upon combustion in the cylinder combustion
11 chamber, compress and propel the new air or air/fuel mixture from the
12 intake/compression chamber, into the cylinder combustion chamber, and in the same
13 action, scavenge and exhaust combustion by-products from the cylinder combustion
14 chamber, and,

15
16 (d) receive, disperse and recoup lubricating oil for return to the oil
17 sump/cooler.

18
19 43. An internal combustion engine machine as in claim 27 wherein the means of
20 dispersing oil on the cylinder walls and of then gathering excess for return to the oil
21 sump comprises oil hoarding rings, at least one ring located near the head and base of
22 at least one piston, such that the rings contain any oil dispersed between them, and
23 when in motion, push said oil before them, substantially wiping it off the cylinder walls
24 as they move.

1 44. An internal combustion engine machine as in claim 27 wherein a means of
2 segregating the oil in the sump and/or crank case from the air or air/fuel mixture in the
3 cylinder comprises at least one compression wall and piston rod pressure seal at the
4 base of at least one cylinder;

5
6 (a) the compression wall segregating the fuel, air, or combustion by-
7 products in at least one cylinder from the lubricating, and, or, or, oil in the oil
8 sump/crankcase, thus creating at least one segregated and sealed intake chamber into
9 which the air or fuel/air mixture is first received from the carburetor, breather, or other
10 combustion air source, and from which it is discharged into the cylinder combustion
11 chamber; and

12
13 (b) a piston rod passing through the compression wall at the base of each
14 corresponding cylinder and into the sump/crankcase by way of the compression wall
15 and pressure seal.

16
17 45. An internal combustion engine machine as in claim 27 wherein a means of
18 encasing, protecting, and lubricating the drive train comprises at least one combination
19 crankcase, and, or, or, oil sump;

20
21 46. (previously amended) An internal combustion engine machine as in claim 27
22 wherein a means of storing and/or cooling the oil between cycles of circulation
23 comprises at least one combination crankcase/oil sump;

1 47. An internal combustion engine machine as in claim 27 wherein a source of intake air
2 comprises at least one carburetor;

3
4 48. An internal combustion engine machine as in claim 27 wherein a means of igniting
5 the fuel comprises an electrical spark;

6
7 49. An internal combustion engine machine as in claim 27, wherein a means of
8 transporting, dispersing, gathering and returning lubricating, and, or, or, cooling oil while
9 keeping it segregated from combustion air and fuel comprises;

10
11 (a) at least one dynamic force lubricating oil pump comprising at least one
12 piston rod/lubrication assembly that serves as both at least one means of transmitting
13 force to and from the piston and as at least one means to transmit lubricating/cooling oil
14 to as associated cylinder via at least one multi-function piston assembly;

15
16 (b) at least one multi-function-piston assembly comprising at least one
17 piston rod with at least one multi-function piston attached to either or each end, and
18 having one or more oil pick-up and exhaust ports in its mid section, and one or more oil
19 transport passages in the piston rod from the oil pick-up nozzles to the multi-function-
20 piston and back to the oil exhaust ports;

21
22 (c) each multi-function-piston comprising one or more radially
23 situated oil inlet and outlet ports that distribute lubricating oil to the associated

1 cylinder and recover the oil for return to the sump/crankcase, and each multi-
2 function piston also comprising;

3
4 (d) at least one oil hoarding ring near each piston head and base to
5 assist in dispersing and then re-gathering the oil for return to a sump such that oil
6 flows through the piston rod and piston, and around the piston, lubricating and
7 cooling piston walls, piston rings and cylinder walls, and returns through the
8 piston and piston rod to the oil sump.

9
10 50. An internal combustion engine machine as in claim 27 wherein at least one wrist pin
11 links each piston to its piston rod.

12
13 51. An internal combustion engine machine as in claim 27 wherein a means of igniting
14 fuel in the cylinders comprises explosive compression in the cylinder head.

15
16 52. An internal combustion engine machine as in claim 27 wherein a means of igniting
17 fuel in the cylinders comprises at least one glow plug.

18
19 53. (previously amended) An internal combustion engine machine as in claim 27
20 wherein a means of igniting fuel in the cylinders comprises at least one electrical spark.

21
22 54. An internal combustion engine machine as in claim 28 wherein a means of
23 transmitting energy to and from the pistons comprises at least one piston-rod between

1 and joining each pair of pistons in each cylinder bank such that each piston rod has a
2 piston at each end,

3
4 (a) each piston rod passing through the base of its associated cylinder,
5 each piston rod carrying the force of its associated piston power stroke to the drive train,
6 and across to the opposite associated piston, thereby, powering that piston's
7 compression stroke, and

8
9 (b) at least one piston rod linked, directly or indirectly, to a drive shaft, via
10 at least one rotary or linear energy transmission device.

11
12 55. An internal combustion engine machine as in claim 28 comprising at least one
13 plurality of banks of cylinders, each bank comprised of two or more cylinders and the
14 drive train of each bank joined to the drive train of its neighboring bank(s) in such a way
15 that each bank may be independently disconnected from its neighbor(s) and shut down
16 automatically or at the discretion of the operator, the manner of joining the bank drive
17 trains being, in example, manual clutch(es), centrifugal clutch(es), or ratchet devices.

18
19 56. An internal combustion engine machine incorporating significant improvements in
20 power, efficiency and emissions control comprising;

21
22 (a) one or more cylinders, each comprising at least one head, combustion
23 chamber, base, compression chamber and sidewall;

24 (b) one or more means of igniting fuel in the cylinder(s);

1 (c) one or more sources of intake air;

2
3 (d) at least one means of storing and/or cooling lubricating oil between
4 cycles of circulation;

5
6 (e) a drive train;

7
8 (f) at least one means of encasing, protecting, cooling and lubricating the
9 drive train;

10
11 (g) at least one means of segregating the oil in the sump and/or crankcase
12 from the air or air/fuel mixture in the cylinder;

13
14 (h) at least one means of dispersing oil on the cylinder walls and of then
15 gathering excess for return to the oil sump;

16
17 (i) at least one means of transmitting energy to and from the pistons;

18
19 (j) at least one means of guiding each piston rod such that it moves in a
20 linear manner, always along substantially the same line;

21
22 (k) at least one means of drawing air or air/fuel mixture into the engine
23 machine, propelling it into the cylinder combustion chamber, compressing it for ignition
24 and propelling its expulsion after ignition;

1 (l) at least one means of admitting air and fuel, or air/fuel mixture into each
2 cylinder;

3
4 (m) at least one means of efficiently expelling exhaust gases resulting
5 from combustion of the air fuel mixture after energy has been extracted;

6
7 (n) at least one means of transmitting energy from the piston rod to the
8 drive train;

9
10 (o) at least one means of cooling the engine; and

11
12 (p) at least one means of transporting, dispersing, gathering, and returning
13 lubricating/cooling oil while keeping it segregated from combustion air and fuel;

14
15 (q) wherein, the means of transporting, dispersing, gathering and returning
16 lubricating/cooling oil while keeping it segregated from combustion air and fuel
17 comprises at least one dynamic force lubricating oil pump comprising;

18
19 (r) at least one piston rod/lubrication assembly that serves both as
20 at least one means of transmitting force to and from the piston and as at least
21 one means to transmit lubricating/cooling oil to and from its cylinder in concert
22 with at least one multi-function piston;

1 (s) the piston rod/lubrication assembly comprising at least one
2 piston rod with a multi-function piston attached to each end, oil pick-up nozzles
3 and exhaust ports in its mid section, and oil transport passages in the piston rod
4 from the oil pick-up nozzles to the multi-function piston and back to the oil
5 exhaust ports;

6
7 (t) the multi-function piston comprising at least one piston
8 configured with one or more radially situated oil inlet and outlet ports that
9 distribute lubricating oil received from the piston rod/lubrication assembly,
10 to the associated cylinder, and that recover the oil for return to the
11 sump/crankcase via the piston rod/lubrication assembly; and

12
13 (u) the multi-function-piston assembly also comprising oil hoarding rings
14 near each piston head and base to assist in dispersing and then re-gathering the oil for
15 return to the cooling, sump such that oil flows through the piston rod and piston, and
16 around the piston, and returns through the piston and piston rod to the oil sump/crank
17 case.

18
19 **57. An engine machine as in claim 27 wherein the means of admitting air or**
20 **air/fuel mixture into each cylinder is a "pop-top" piston comprising a valve in the**
21 **piston head that periodically opens to admit new air or fuel/air mixture for each**
22 **combustion.**

1 **58. An engine machine as in claim 27 wherein the means of admitting the fuel**
2 **component of the air/fuel mixture into each cylinder is via a fuel injector for each**
3 **cylinder.**